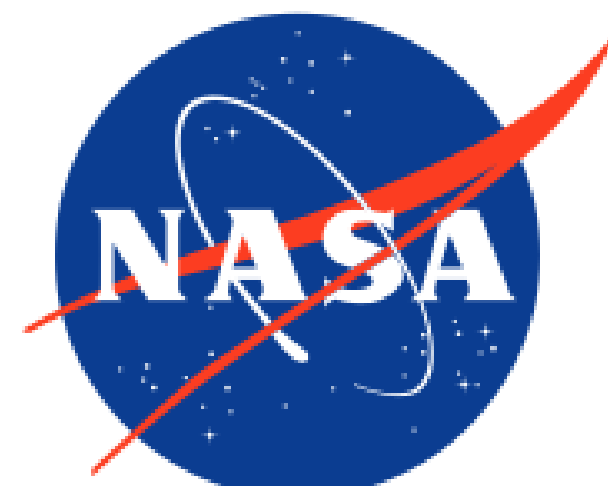




FUNCTIONAL TASK TESTS IN PARTIAL GRAVITY DURING PARABOLIC FLIGHT



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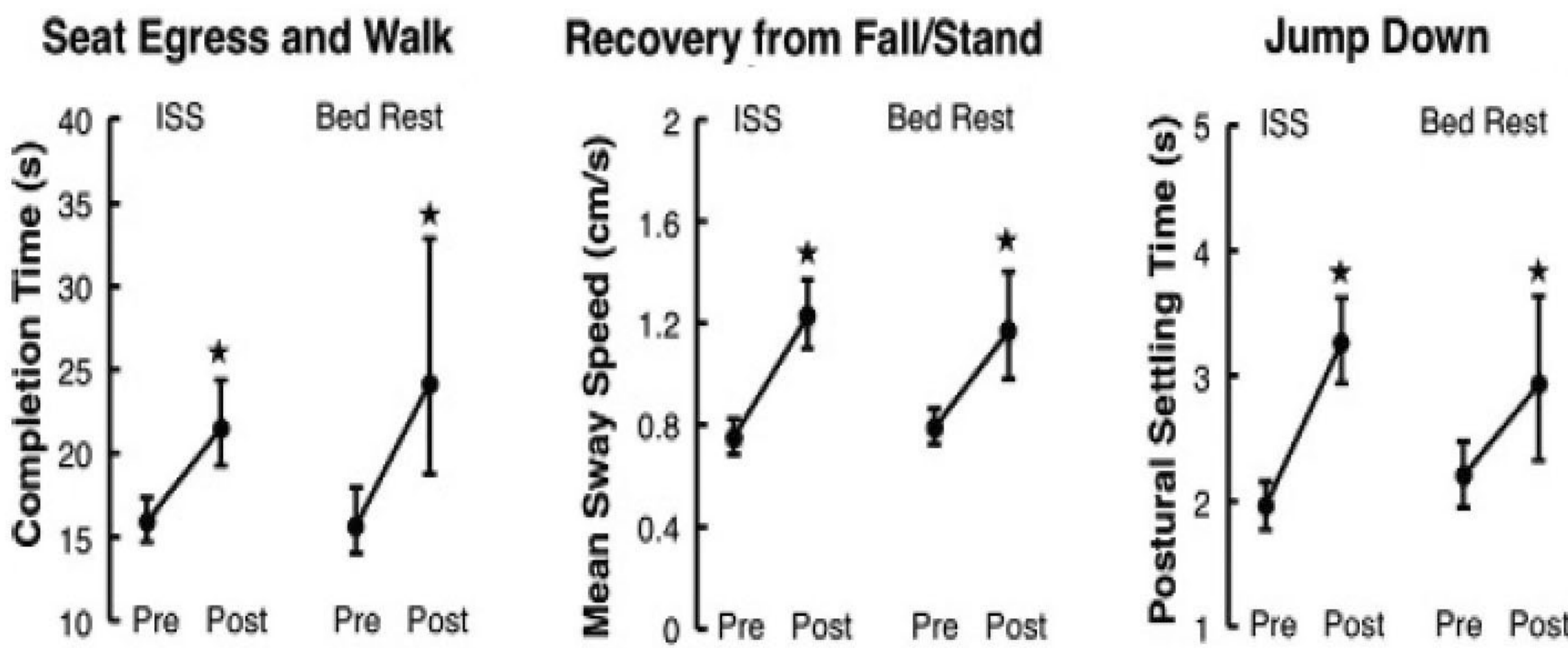
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BACKGROUND

- Understanding how functional tasks are performed in partial gravity (partial-g) is necessary to define effective and comprehensive countermeasure strategies for preserving crew performance during exploration-class missions, such as on the Moon or Mars.

- Changes in 1G performance metrics before (Pre) and after (Post) 6-month stays on the ISS and 70-day bed rest.

(Mulavara et al., MSSE, 2018)



OBJECTIVES & HYPOTHESES

- We propose to study the performance of functional tasks during the partial-g phases of parabolic flight (0.25g, 0.5g, and 0.75g).
 - These tasks will be performed using similar equipment and procedures as those used with astronauts returning from spaceflight and with ground subjects after prolonged bed rest.
- We hypothesize that partial-g during parabolic flight will cause acute changes in vestibular, proprioceptive, and sensorimotor functions, and these changes will impact the performance of mission critical tasks.
- The largest changes in performance are expected at the lowest gravity level (0.25g) due to alterations in gravitational reference for the perception of vertical and effects of altered loading.

PARABOLIC FLIGHT CAMPAIGN

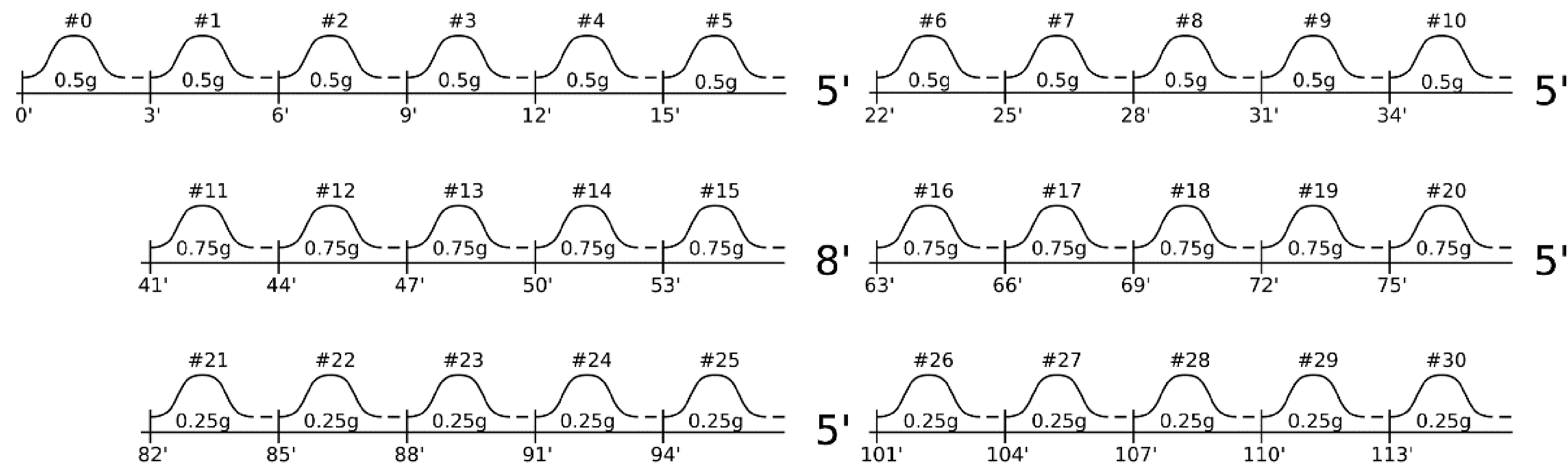
- Novespace, Mérignac, France:
 - June 12th – 16th, 2023
- 30 parabolas each flight:
 - 10 parabolas each partial-g level (0.25g, 0.5g, 0.75g).
 - Additional testing during 1g phases.
- 12 subjects: healthy non-astronaut adults, ages 18-65.



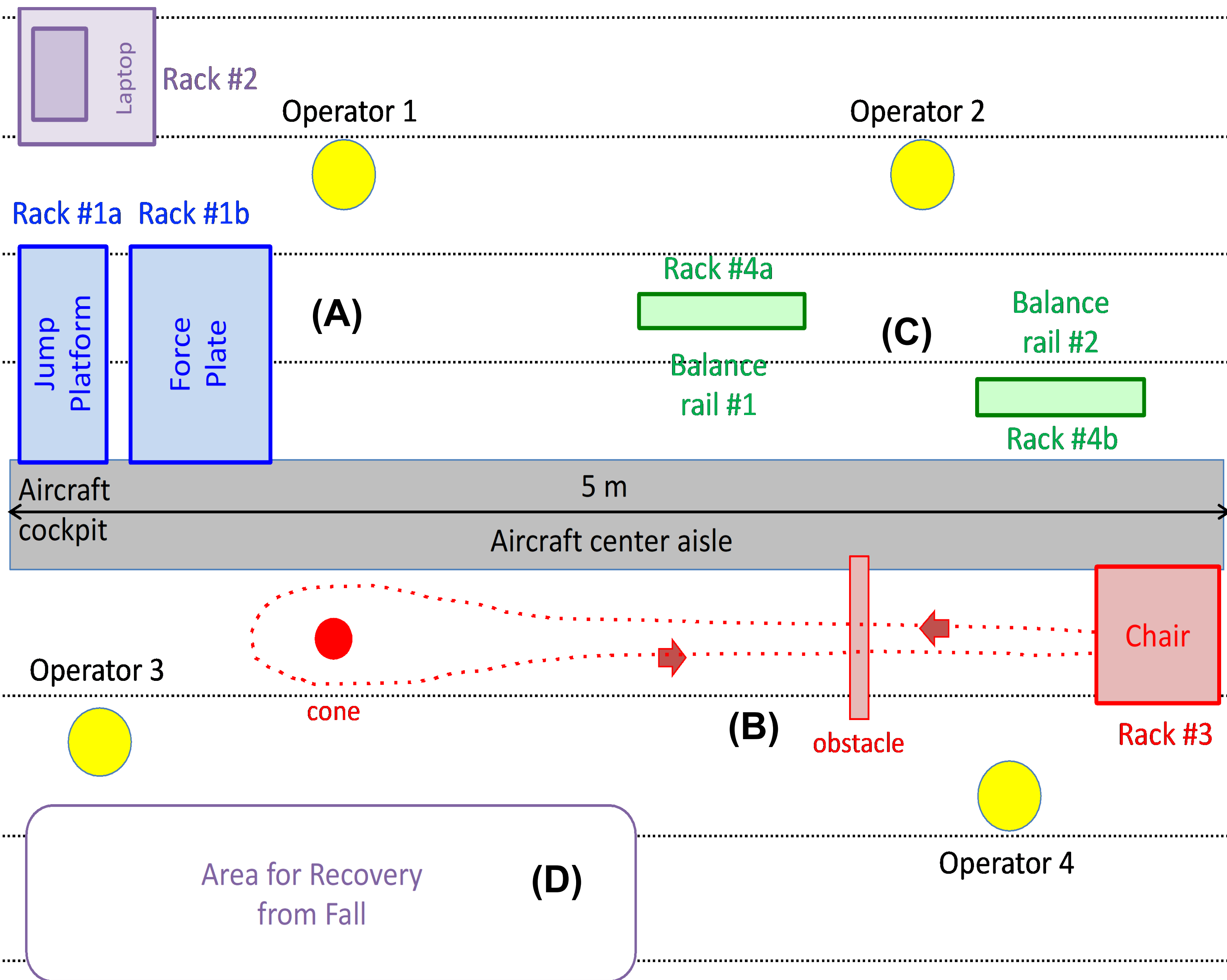
- Parabola durations:

Type of parabolas	Reduced gravity duration	Duration of complete parabola	Duration between two parabolas	Parabolic duration and break before the next one
0g	21-22"	1'15"	1'45"	3'
0.25g	27"	1'14"	1'46"	3'
0.5g	39"	1'22"	1'38"	3'
0.75g	52"	1'30"	1'30"	3'

- Sample flight schedule:



METHODS



- Functional task tests: (A) Jump Down; (B) Sit-to-Stand and Obstacle Walk; (C) Tandem Stance with Eye Open/Closed; (D) Recovery from Fall.
- Recordings include time to complete, head/body motion, limits of stability, heart rate, and motion sickness symptoms.

DATA ANALYSES

- Each subject's values will be compared to their respective values in 1 g (i.e., each subject will serve as their own control).
 - The mixed-model regression analysis will be applied to each of the outcome measures to flag noticeable effects of relative to the gravity level. The number of comparisons will be four (0.25 g, 0.5 g, 0.75 g, 1 g).

RELEVANCE

- These data will help establish gravitational dose-response relationships and determine the gravity threshold for these functional tasks.
- Comparisons to previous results in astronauts and bed rest participants will help with understanding the true extent of functional task performance deficits in partial gravity
 - This information could be used to assess performance risks and inform the design of countermeasures for exploration-class human missions.

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